Attitude Towards Mathematics and the Relationship Between Such Attitude and Grade Obtained In a Freshman Mathematics Course

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CHAPTER I

INTRODUCTION

The investigation of the relationship between attitudes toward mathematics and scores in mathematics courses is based, necessarily, upon several assumptions. It is assumed that attitudes are among the variables that affect human behavior. This assumption is given stronger emphasis by the definition of the concept of attitude used in this study. As used herein, attitude refers to belief. As Ferguson (3) has stated, "We believe something is right or that something is wrong. We favor this and object to that. We accept this position and reject that position. This believing or disbelieving, this favoring or not favoring, this accepting or rejecting, constitute expressions of attitude."

It is further assumed that attitudes are learned, and as such they must involve the problems of perception and motivation. How a person perceives the attitudes of others who are significantly involved in the formation of his attitudes, and his own direct involvement in mathematical experiences will have a direct influence upon the formation of his attitudes. Once formed, the attitude toward mathematics should then become a "motive" in the sense that decisions

which involve mathematics will be influenced by the person's attitude towards mathematics. It would seem to follow that attitudes may be thought of as mediating in reference to overt responses. This is to say that there should be a relationship between an attitude toward a thing and the behavior by an individual with reference to this thing (2).

Given the assumption that attitudes are learned and involve the problems of perception and motivation, we become concerned with the persons and the experiences which influenced the formative and developmental perceptions toward the object, mathematics. It is assumed that the attitudes of an individual are greatly influenced by the attitudes of the significant persons involved in the learning experiences of the individual concerned with mathematics. Poffenberger and Norton (6) found that parents determine the initial attitudes of their children and affect their achievement in arithmetic and mathematics. They stated that there were three factors involved: (1) parental expectation of the children's achievement, (2) parental encouragement regarding these subjects, and (3) parental attitudes toward arithmetic and mathematics. They also stated that arithmetic and mathematics teachers have a strong positive or negative effect upon the student's attitudes and achievements in these areas. With regard to this latter statement, Davis (1) stated that the teacher, who is not able to explain his ideas so that the student can accept them and understand them, but who nonetheless is prepared to insist

upon these ideas, is one of the major sources of resentments and feelings of inadequacy among mathematics students. The writer, who taught mathematics for a short time, maintained the idea that the less dogmatic teacher would have a more positive effect upon the student.

In order to ascertain some of the origins of the attitudes toward mathematics measured in this study and what people influenced their formation and development, this study used five open-ended-type questions. One purpose of the questions was to get the persons tested in this study to give their remembered perceptions of the attitude of the person who influenced them most in their attitude toward mathematics. Another purpose was to get an indication of the remembered perception of the attitudes of some of the significant people usually involved in the formation and development of attitudes towards mathematics. Questions were asked concerning the attitudes toward mathematics of elementary school teachers, secondary school teachers, and of parents of the subjects used in this study.

Thus, at any given time, when the individual is in a situation which calls for the expression of his attitude toward mathematics, a measure of this attitude should give a reflection of his perceptions of the experiences and attitudes of the persons influencing the formation and development of his attitude, and this measure should give an indication of his behavior in that particular situation. This is to say that a student's attitude toward mathematics will influence his decision about taking or not taking a mathematics course during his

first semester in college. His attitude toward mathematics will be a factor in selecting the particular mathematics course with reference to its difficulty once the decision is made to take a mathematics course. And, finally, a measure of this attitude should be a predictor of the student's behavior in the particular mathematics course, i.e., his achievement as indicated by a course score or grade.

The two mathematics courses chosen were those available to entering Freshmen. These courses are designated as C142 and Ma105 and are described in the University of Florida Catalog as follows. C142 is one of the basic comprehensive courses offered by the University College of the University of Florida and covers the development of the number system, computation with approximate and exact numbers, algebra as a generalization of arithmetic, practical geometry, functional relationships, logarithms, the simple trigonometry of the triangle, simple and compound interest, and annuities. Ma105 is the basic mathematics course offered by the Department of Mathematics. This course offers a sequence of topics including college algebra, trigonometry, analytic geometry, and some calculus in an effort to present mathematics as an integrated whole rather than as a series of segregated topics. A course entitled Practical Logic, C141, may be taken in lieu of C142.

Selection of one of these two mathematics courses or of neither is made during the week before classes are to begin. The

selections are made in a conference between a counselor and the student with the student's record of past achievement used in the selection proceedings.

An obvious assumption in this study is that attitudes can be measured. However, there have been differences of opinion as to the measuring techniques which are best suited for attitude measurement. Three principal measuring techniques seem to have emerged out of the investigations concerned with attitude measurement. These are Thurstone's method of equal-appearing intervals, Likert's method of summated ratings, and the forced-choice method first reported in Personnel Psychology (1948) by E. Donald Sisson. In both the equal-appearing interval and the forced-choice methods, the scaling of items takes place before the collection of the attitude data. The scaling of test items takes place after the collection of the attitude data in the use of the summated ratings method.

The first of the above methods to stir interest in the attempt to measure objectively attitudes was that of Thurstone and Chave (9) who published a monograph entitled, "The Measurement of Attitude. . . ." Likert (4) followed three years later in 1932 with a published monograph entitled, "A Technique for the Measurement of Attitudes." Between these dates and 1948, and since 1948, when Sisson (8) published his article entitled, "Forced Choice - The New Army Rating," many articles have been written concerning the relative merits and demerits of the different approaches. Taking note of the differing

opinions it was decided that this study might be useful in exploring the relative efficiency of the differing approaches to attitude measurement when applied to the same population.

In summary, one of the purposes of this study was to determine the degree and direction of the assumed relationship between attitudes toward mathematics, in general, and the grades received in specific mathematics courses taken during the first semester of the freshman year, the latter representing an objective measure of the behavior mediated by the attitude. It was hypothesized that the relationship would be demonstrated to exist, and that this relationship would be direct and positive; i.e., the more favorable the attitude as measured by the measuring devices, the better the score or grade received. A basic hypothesis was that attitude score would differentiate between mathematics categories for each scale.

A further purpose of this study was to investigate the relative efficiency of the three principal measuring devices or techniques which have been developed in the measurement of attitudes. No explicit hypothesis was made with reference to this part of the study. An implicit assumption was that there would be differences in the efficiency of predicting achievement, but no hypothesis concerning their relative merit was made.

A third purpose of this study was to obtain information indicating the origins of the attitudes toward mathematics of the persons tested as well as the remembered perceptions of the attitudes

of the people who were significant in the formation and development of these attitudes.

CHAPTER II

PROCEDURE AND DESIGN

With the exception of late registrants, all entering freshmen for the School Year 1958-1959, were tested on one of the three scales used in this study. All scales were administered immediately following regular admissions-testing, and were completed within a four-day period. Testing was completed prior to the first day of classwork. No more than one scale was administered to any of the eight time groups comprising the freshman admissions-testing group. The scales were alternated according to the following paradigm:

Day	Scale	
	A.M.	P.M.
1	1	2
2	3	1
3	2	3
4	1,2,3	1,2,3

On the fourth day, all three scales were used as needed to enable both groups to be tested. Since the attempt to obtain attitude measures for the entire freshman class was practically successful, the data gathered are assumed to represent information about a certain

population. Such an assumption and the fact that the relatively large N of about 3000 cases was obtained permitted a certain amount of freedom in the design and statistical procedures utilized. Thus, the population studied is defined as those students who took the admissions testing program at the prescribed time during the week prior to the beginning of classes for the Fall Semester of the School Year 1958-1959.

Included in the design of the study was an investigation of the relative efficiency of each type scale used in testing the primary hypothesis. The scale selected to represent the Thurstone-type scale was one developed by Miss Martha J. Muth (5) in a Master's study performed at the University of Florida. A scale developed by H. H. Remmers and Ella Belle Silance (7) was selected to represent the summated ratings method. This scale also represents Remmer's belief in the use of generalized attitude scales. For this study, Form A of "A Scale For Measuring Attitude Toward School Subjects" was used in its entirety. A forced-choice-type scale was developed by the author to represent the third measuring technique. Items used in this scale were formulated by the chairman of the author's committee and the author and included some selected statements from Form B of "A Scale For Measuring Attitude Toward School Subjects" as developed by Remmers and Silance. A list of statements used in Scale 3 appears in the Appendix.

The attitude scale comprised the second page of the two-page

test booklet distributed to each student. The first page included identifying data and a set of five open-end questions relating to the origin and development of the student's attitude toward mathematics. Each student furnished the following identifying data: Name, Student Number, Sex, Veteran Status, Marital Status, Specific Mathematics courses taken in high school, and name of high school. Each student was requested to complete as briefly as possible the following five statements:

1. The person (IDENTIFY - DO NOT NAME) who influenced me the most in mathematics was _____.
2. This person had an attitude towards mathematics that can be described best as _____.
3. My grade school math teachers thought math was _____.
4. My high school math teachers thought math was _____.
5. My parents thought math was _____.

These five statements were scored by the author on the following basis. Five categories were assigned to the first statement. These were: (1) Teacher, (2) Parent, (3) Sibling, (4) No answer, and (5) Other. Answers to each of the other four statements were assigned to three categories. These were: (1) Favorable, (2) Unfavorable, and (3) Other. The category "Other" for the last four statements included answers which were not determined by the author as either favorable or unfavorable, as well as those left blank indicating "No answer."

The attitude scales were scored according to the norms established by the authors of the respective scales.

One of the advantages, and procedurally one of the requisites, for testing the population was that the large population N permitted a reasonably large N for each scale. All freshmen students were tested necessarily since there was no way at the time of testing to differentiate which students or how many students would elect to take one of the two mathematics courses offered or to take no mathematics course. Another advantage was that of obtaining information about the students who chose not to take any mathematics course. In essence this provided an opportunity for a second categorization of the students tested. The following paradigm illustrates the two categorizations thus far permitted by the design.

Msl05	Ch2	No Math
Scale 1	Scale 1	Scale 1
Scale 2	Scale 2	Scale 2
Scale 3	Scale 3	Scale 3

Hence the testing of the population permitted the use of three scales as well as the use of three mathematics categories resulting in a large N for each of the three scale categories within each of the three mathematics categories. It is believed that such a procedure permitted a more definitive testing of the first two hypotheses.

Although the above advantages accrued from the testing of the "population," there were certain disadvantages. One disadvantage was the time consuming and laborious task of handscoring such a quantity

of data. Especially this was made more difficult by the failure of about 40 per cent of the students who were tested by the forced-choice scale to complete the scale according to directions. This scale included twenty-four pairs of statements. They were scored upon the basis of a 1 or a 2 for marking either the first or second statement respectively as their choice in each pair. An arbitrary decision was made to include those tests which contained no more than five "errors." Errors were defined to mean either marking both statements in each pair or marking neither statement in each pair. These tests then were scored upon the same basis as the other tests in the forced-choice scale with an additional score of 1.5 being assigned to those statements which met the definition of being errors. This procedure permitted the inclusion of about 90 per cent of the data collected for the forced-choice scale.

A second disadvantage was the process of transferring the identifying data and the raw score data to IBM data sheets for handling by the statistical laboratory. A decision was made to sample the population. A sample of 100 cases was drawn for each of the three scale categories within each of the three mathematics categories. It was assumed that samples of 100 could represent the groups. Equal N's simplified handling in statistical procedures and reduced the labor involved.

	Mathematics Course Taken		
Scale	Ms105	Ch2	No Math
1	100	100	100
2	100	100	100
3	100	100	100

Approximately the same number of students took each of the three attitude scales. The number taking Scale 1 was about 1100. An N of about 1000 was obtained for Scale 2, and an N of about 900 was obtained for Scale 3. The sample for the sub-category designated by Ms105 and Scale 3 was drawn from a total of about 250 cases. This category was the smallest of the nine sub-categories. Although it was the smallest of the nine sub-categories, the other sub-categories in the category designated by Ms105 were no more than 100 to 150 cases larger in the number of cases contained. Each of the nine samples was drawn in the following manner. If a sub-category contained 300 cases, every third case was drawn to obtain the sample of 100. This procedure was followed for each of the nine sub-categories. Although there were approximately the same number of cases for each scale within a particular mathematics category, the total Ns for each mathematics category differed. Ms105 contained the smallest number; Ch2 the next largest N; and the no math category contained the largest number of cases.

After the samples for the nine sub-categories had been drawn, the identifying data, the attitude score, and the score assigned each

of the five statements were coded and placed upon IBM data sheets. The cumulative semester raw score, i.e., a total score, for those students who selected either of the mathematics courses was reproduced by IBM equipment form the semester grade cards provided by the Board of University Examiners. Likewise, the A.C.E., Q, L, and T scores for all students in the samples were reproduced from IBM cards supplied by the Board of University Examiners. These data supplied the necessary information for the statistical procedures to be used.

A Pearsonian coefficient of correlation was obtained between each attitude scale score within a particular mathematics course and the total score (cumulative semester raw score) in that mathematics course. This meant that six coefficients of correlation were obtained—three coefficients between the attitude score for each of the three scales and the total score in Ms105 and three coefficients between the attitude score for each of the three scales and the total score in Ch2. This procedure permitted a comparison between scales with respect to the ability of each scale to predict total score in each of the two mathematics courses. It was assumed that the correlations between attitude scale score and mathematics total score would be higher for Ms105 since those students who took this more advanced course would supposedly tend to have attitudes which were more stably formulated. As stated in the Introduction, there were no hypotheses concerning the relative efficiency of the three scales, but this procedure permitted a partial evaluation of this relative efficiency.

A further statistical procedure was to perform an analysis of variance for attitude scale score by mathematics category for each attitude scale. It was hypothesized that this procedure would provide a more definitive answer to the first purpose of this study. Specifically, it was hypothesized that attitude scale score would significantly differentiate between mathematics categories. An additional evaluation of the relative efficiency of each scale was provided also by this procedure.

A Pearsonian coefficient of correlation was computed between attitude scale score and A.C.E., Q, L, and T scores within each mathematics status group. This meant that a total of twenty-seven coefficients of correlation were obtained by this procedure. These coefficients gave a measure of the relationship between attitude toward mathematics and the raw scores representing information about (1) each student's ability to deal with abstract and quantitative material as measured by A.C.E., Q; (2) each student's ability to deal with material more linguistic and verbal in nature as measured by A.C.E., L, and (3) each student's general ability as measured by the total or composite score which was a summation of A.C.E., Q, and A.C.E., L, yielding A.C.E., T. This procedure permitted a further evaluation of the relative efficiency for each scale.

A Pearsonian coefficients of correlation was computed between mathematics total score for either Mel05 or Ch2 and A.C.E., Q, L, and T. This procedure resulted in six correlations and yielded a measure

of the relationship between total score in mathematics and a total measure of general ability (A.C.E., T) as well as a measure of the relationship between total score in mathematics and quantitative ability (A.C.E., Q) and linguistic or verbal ability (A.C.E., L).

A simple count by category was made for each of the five open-end statements which were included on the first page of the test booklet. This procedure permitted a comparison using the Chi Square test of the answers to these statements by mathematics status group. It was assumed that there would be differences in the categories between mathematics status groups. Specifically, it was assumed that students who chose Ms105 would have had experiences with persons whose attitude toward mathematics would be more favorable than the attitudes of the persons with whom the students in C&2, or no mathematics course, came into contact.

In the collating process, one of the 900 cases selected could not be identified. This case was in the no mathematics category for Scale 3. A case was selected by chance from each of the other eight sub-categories resulting in an N of 99 for each of the nine sub-categories and a total N of 891.

CHAPTER III

RESULTS AND DISCUSSION

The results concerned with the first purpose of this study indicated that the first hypothesis had to be rejected. The attempt to demonstrate a significant and positive relationship between attitude toward mathematics and performance in a particular mathematics course was not successful. Table 1 presents the coefficients of correlation obtained between attitude score for each scale and total score for each of the two mathematics courses. Each of the coefficients was based upon an N of 99.

TABLE 1

COEFFICIENTS OF CORRELATION BETWEEN ATTITUDE SCORE AND TOTAL COURSE SCORE

Math	Scale 1	Scale 2	Scale 3
Ma105	.1111	.1667	.0430
C42	.1005	.1618	.0780

None of the coefficients was significantly different from a coefficient of 0 for samples of 99. Although the coefficients were

positive in direction, the magnitude of each coefficient did not permit the conclusion that any one coefficient differed from a coefficient of zero except upon a chance basis.

In addition to the probability that these coefficients represented a "true" measure of the relationship between the two variables of attitude and of performance, there were at least two other possibilities which could be useful in the interpretation of the data. There were data pointing to these possibilities. One of these possibilities was that the range of scores for total course score for each mathematics category was restricted or compressed. Inspection of the scores indicated that the range of scores for the cases included in the samples for each mathematics course was of the order of at least 100 points between the lowest score and the highest score. There was no indication that the dispersion of cases about the mean for either scale was a factor in reducing the coefficient of correlation. Both the range and dispersion of total course scores were of a nature to permit the relationship between attitude score and total course score to become evident. Table 2 presents the means and standard deviations for total scores in each of the mathematics courses by attitude scale.

A second possibility was that attitude scale score range was small and that scores tended to cluster about the mean. There was evidence that each of these two events occurred for the attitude scores. The range of scores for Scale 1 occupied approximately the

lower two-thirds of the range of possible scores, and no attitude score in Scale 1 was more than two-thirds the possible score obtainable. Although the range of attitude scores for Scale 2 and Scale 3 appeared adequate, the standard deviations were small. A small standard deviation was found also for Scale 1. The means and standard deviations of attitude scores for each scale in each mathematics category are reported in Table 3.

TABLE 2

MEANS AND STANDARD DEVIATIONS OF TOTAL COURSE SCORES

	Scale 1	Scale 2	Scale 3
		C42	
Mean	115	103	108
St. Dev.	28.4	28.4	24.2
		M105	
Mean	110	105	106
St. Dev.	29.6	27.9	27.9

TABLE 3

MEANS AND STANDARD DEVIATIONS OF ATTITUDE SCORES

	Scale 1	Scale 2	Scale 3
		C42	
Mean	3.10	6.12	36.4
St. Dev.	.83	.67	2.69
		Ma105	
Mean	2.74	5.80	36.4
St. Dev.	.52	.59	2.89

Thus, in Scale 1, both the limited range of scores and the apparent clustering of scores about the measure of central tendency may have influenced the magnitude of the coefficient of correlation between attitude score and total course score. Likewise for Scales 2 and 3, the clustering of cases about the mean as indicated by the relatively small standard deviations may have depressed the coefficients of correlation between the two variables.

Although there appeared to be no relationship between attitude toward mathematics and performance in a mathematics course, analysis of variance computed for attitude score by mathematics course for each of the three scales revealed a relationship between attitude score and

membership in mathematics category. Table 4 presents the results of the analyses of variance for the three scales.

TABLE 4

ATTITUDE SCALE SCORE BY MATHEMATICS COURSE ELECTED

Source of Variation	Sum of Squares	df	Mean Square	
	Scale 1			
Between Groups	20.072	2	10.0360	
Within Groups	259.386	294	.8822	
Total	279.458	296		F- 11.375
	Scale 2			
Between Groups	16.9600	2	8.4800	
Within Groups	115.5690	294	.3930	
Total	132.5290	296		F- 21.57
	Scale 3			
Between Groups	3.2200	2	1.6100	
Within Groups	2418.3800	294	8.2250	
Total	2421.6000	296		F-.1957

The Fs for both Scale 1 and Scale 2 were significant at the .01 level of confidence. The F for Scale 3 was not significant. For both Scale 1 and Scale 2, mathematics status groups differed significantly with respect to attitude score. This is to say that there was a relationship between attitude score and being a member in one of the mathematics categories. In each of these two scales, the mean attitude score was lower (more favorable) for those taking Ms105 than for those who took either Ch2 or no mathematics course. For both Scales 1 and 2, mean attitude score was lower for those taking Ch2 than for those who took no mathematics. In essence, the results yielded a hierarchy of mean attitude scores with favorableness toward mathematics declining from most favorable in Ms105 to least favorable in the no math category.

With regard to the first purpose of this study, the foregoing results seemed to indicate that there was no relationship between attitude toward mathematics and performance in a particular course. However, the mathematics categories did differ significantly in degree of favorableness of attitude toward mathematics for two of the scales. This meant that for Scales 1 and 2 the most favorable attitude score toward mathematics would be more likely to be found in the mathematics category Ms105. Favorableness decreased for the attitude score in Ch2 and no math categories in that order.

As might be expected, general ability appeared to be a better predictor of total course score than did attitude toward mathematics

as measured by the three attitude scales. The coefficients of correlation between A.C.E., Q, L, and T raw scores and total course score for each of the mathematics categories indicated that (1) nine of the eighteen coefficients were significant at the .01 level of confidence, (2) six more of the coefficients were significant at the .05 level of confidence, and (3) three of the coefficients did not differ significantly from a coefficient of 0 for samples having an N of 99. These coefficients are presented by scale in Table 5.

The coefficients reported in Table 5 were then averaged by converting each coefficient into its corresponding Fisher z value. Table 6 presents the averaged coefficients of correlation for the coefficients in each scale, combined according to mathematics course taken. The averaged coefficients are both positive and significant. Coefficients representing the relationship between total course score and A.C.E., Q were significant at the .01 level of confidence. The same held true for the relationship between total course score and A.C.E., T score. The coefficients representing the relationship between A.C.E., L and total course score were significant at the .05 level of confidence.

The second purpose of this study was to investigate the relative efficiency of the three scales measuring attitude toward mathematics. In the investigation of the first purpose of this study, the results of Table 2 provided the first opportunity to compare these scales with an external criterion. There appeared to be no significant

TABLE 5

COEFFICIENTS OF CORRELATION BETWEEN A.C.E., Q, L, AND T AND TOTAL COURSE SCORE IN MS105 OR CH2

A.C.E.	Ms105	Ch2
	Scale 1	
Q	.3766**	.3707**
L	.2507*	.3078**
T	.3392**	.3854**
	Scale 2	
Q	.2405*	.4725**
L	.1806	.1238
T	.2397*	.3226**
	Scale 3	
Q	.1459	.3998**
L	.2119*	.2314*
T	.2163*	.3293**

*Significant at .05 level of confidence
**Significant at .01 level of confidence

TABLE 6

AVERAGE COEFFICIENTS OF CORRELATION BASED ON COMBINED COEFFICIENTS OF CORRELATION FROM THE THREE ATTITUDE SCALES

A.C.E.	Total Course Score	
	Ms105	Ch2
Q	.263**	.440*
L	.216*	.223*
T	.270**	.360**

*Significant at the .05 level of confidence
**Significant at the .01 level of confidence

differences in the ability of the attitude scales to measure attitude toward mathematics based upon the external criterion of predicting performance in a particular course. None of the coefficients were significantly different from 0 for samples having N's of 99. Although the magnitude of the coefficients was numerically greater for Scales 2 and 1 than for Scale 3, these coefficients did not differ significantly among themselves. However, the analyses of variance of attitude score by mathematics category for each scale indicated that both Scales 2 and 1 were doing a better job of measuring attitude than Scale 3. At least these two scales differentiated between mathematics category with respect to favorableness toward mathematics while Scale 3 did not. Categorization by attitude scale seemed to

have little, if any, influence upon the coefficients obtained for the relationship between performance in a mathematics course and ability as measured by A.C.E., Q, L, and T raw scores. There seemed to be differences by scale for the relationship between attitude score and the same measures of ability. The coefficients between the two variables of attitude score and ability are reported in Table 7. Of the twenty-seven coefficients, only eight were significant. Scales 1 and 2 had more coefficients which were significant than did Scale 3. In general, it appeared that Scales 1 and 2 better measured attitude toward mathematics than did Scale 3. Scale 2 gave the highest coefficients and F. This result does not seem surprising in view of the fact that this scale was standardized upon a University of Florida population which included students taking Ch2. Scale 1 gave intermediate coefficients and F, and it was general in its standardization with respect to place and subjects. Scale 3 provided the lowest coefficients and F, and it was experimental in nature. The standardization subjects were students in a section of General Psychology. These results indicate that the Thurstone-type scale developed by Muth and the Remmers scale were better measures than the forced-choice-type scale. The difficulty previously reported in scoring Scale 3 because many students failed to follow the printed directions prohibits a clear-cut evaluation of the efficiency of Scale 3. This study did point out that administration of a forced-choice-type scale to large groups leaves much to be desired in the

TABLE 7

COEFFICIENTS OF CORRELATION BETWEEN ATTITUDE SCALE SCORE AND A.C.E., Q, L, AND T

A.C.E.	Ms105	Ch2	No Math
	Scale 1		
Q	.0439	.0534	.2333*
L	.3026**	.1716	.1779
T	.2172*	.1165	.2273*
	Scale 2		
Q	.1967*	.1040	.0823
L	.0690	.0394	.2385*
T	.1368	.0237	.2206*
	Scale 3		
Q	.1319	.0210	.1793
L	.0250	.2385*	.0873
T	.0134	.1767	.1447

*Significant at .05 level of confidence
**Significant at .01 level of confidence

interpretation of results gathered by such a procedure.

The third purpose of this study was to investigate the attitudes of some of the persons who were involved in the formation and development of the attitudes measured in this study. This investigation was carried out by using five open-end questions to ascertain how these subjects in this study now perceive the attitudes of those persons who influenced them in the formation and development of their attitudes. Table 8 presents the results by category of the identity of the person designated as being most influential in the formation and development of the attitudes measured in this study.

TABLE 8

NUMBER OF RESPONSES BY CATEGORY
FOR STATEMENT 1

Person	Ch2	Mel05	No Math
Teacher	210	235	212
Parent	31	20	27
Sibling	02	03	03
No Answer	13	09	07
Other	41	30	48

Table 9 presents in tabular form the attitudes of the above designated persons as remembered by the subjects in this study.

TABLE 9

NUMBER OF RESPONSES BY CATEGORY
FOR STATEMENT 2

Attitude	Ch2	Msl05	No Math
Favorable	246	253	221
Unfavorable	07	10	20
Other	44	34	56

The category Other in Table 9 included the number of those not responding to Statement 1 in Table 8, those not responding to the Statement 2, and those responses which the author could assign to neither category.

Table 10 presents the results for the remaining three statements. The results for these statements designate the attitudes toward mathematics of (3) the students' elementary school teachers, (4) the students' secondary school teachers and the (5) students' parents.

To determine whether these results were distributed among the categories in a significant manner, Chi Square analyses were performed for each of the statements 1, 2, 3, 4, and 5 to evaluate deviations from those frequencies to be expected by chance.

The Chi Squares for each statement are reported in Table 11.

TABLE 10

NUMBER OF RESPONSES BY CATEGORY
FOR STATEMENTS 3, 4, AND 5

Attitude	Ch2	Ma105	No Math
	Statement 3, Elementary Teachers		
Favorable	231	215	222
Unfavorable	25	37	29
Other	41	45	46
	Statement 4, Secondary Teachers		
Favorable	278	278	262
Unfavorable	03	07	15
Other	16	12	20
	Statement 5, Parents		
Favorable	263	270	257
Unfavorable	22	11	4
Other	12	16	17

TABLE 11

CHI SQUARES

Statement	Chi Square	
1	9.36	(6 df)
2	14.11**	(4 df)
3	3.84	"
4	12.80*	"
5	5.13	"

*Significant at .05 level of confidence
**Significant at .01 level of confidence

The attitudes of the persons most influential in determining the students' attitudes, as well as the attitudes of parents and teachers were reported as favorable. Chi Square tests indicated that students electing mathematics cited unfavorable or ambiguous responses for influencing persons and high school teachers, more rarely than did those taking no mathematics. It is interesting to speculate why such should be the case. One interpretation suggested is that these results reflect each student's own projection of his professed attitude toward mathematics. When these results are viewed in the light of the previously reported tendency for the attitudes measured in this study to occupy either a restricted range of possible scores or to have little dispersion about the measure of central

tendency, the above suggestion seems to have added support. It seems reasonable to assume that people who describe themselves as having favorable attitudes toward mathematics would tend to describe the attitudes of those who most influenced them as being favorable.

The preponderance of favorable answers raised the question of whether the students tested responded with favorable answers which only reflected a somewhat superficial interpretation of what favorable means. It is quite evident that the frequency of favorable responses is significantly different than would be expected by chance. Unfavorable or ambiguous responses are seldom made.

Table 12 presents the number of veterans by mathematics category and scale. Less than 1 per cent (.864) of the students in this study were veterans. The relative number of veterans in each mathematics category was in accordance with expectations. A Chi Square test was performed to determine whether the number of veterans by mathematics category differed significantly from a chance basis. A Chi Square of 8.96 was obtained which was significant at the .05 level of confidence. Analysis of these results indicated that veterans selected Mel05 on a greater than chance basis and rejected a "no mathematics course" alternative on a greater than chance basis.

Table 13 presents the number of married students by mathematics category and scale. Less than 1 per cent (.55) of the students in this study were married. The number of married students in each mathematics category seemed about even.

TABLE 12

NUMBER OF VETERANS BY
MATHEMATICS CATEGORY AND SCALE

	Scale 1	Scale 2	Scale 3
Ch2	11	6	5
Mal05	18	11	9
No Math	8	4	5

TABLE 13

NUMBER OF MARRIED STUDENTS BY
MATHEMATICS CATEGORY AND SCALE

	Scale 1	Scale 2	Scale 3
Ch2	7	6	2
Mal05	8	7	3
No Math	12	3	1

Table 14 presents the number of males and females by mathematics category. There was a hierarchy of number of males and females in the mathematics categories which was in accordance with expectations.

TABLE 14

NUMBER OF MALES AND FEMALES BY MATHEMATICS CATEGORY

	Male	Female
C42	227	70
Ma105	284	13
No Math	160	137

The number of males in a mathematics category increased with a corresponding increase in difficulty of mathematics course. The number of females in a mathematics course decreased with a corresponding increase in difficulty of mathematics course.

CHAPTER IV

SUMMARY

The three purposes of this study were (1) to investigate the relationship between attitude toward mathematics and performance in a particular mathematics course, (2) to investigate the relative efficiency of three different approaches in the measurement of attitudes, and (3) to investigate some of the origins in the formation and development of the attitudes measured in this study.

The hypothesis was rejected that the relationship between measured attitude toward mathematics and performance in a particular mathematics course was positive and significant. The hypothesis was substantiated that there would be a hierarchy of attitude scale score by mathematics status with the most favorable scores occurring in Ms105, then Ch2, and the least favorable scores occurring in no mathematics course. This ordering was apparent for Scales 1 and 2 but not for Scale 3 and was significant at the .01 level of confidence.

The investigation of the relative efficiency of the three scale types led to a conclusion that Muth's Thurstone-type scale, Scale 2, and Remmers scale, Scale 1, were superior in this study to the forced choice scale, Scale 3, constructed by the author. An

interpretation of why this should occur was difficult because of the equivocal scoring procedure necessitated by the students not following the directions for marking Scale 3. An additional factor operating in the relative efficiency of the scales in measuring attitudes was the differing standardization populations. Scale 2 which was standardized upon a University of Florida population and which included students with Ch2 experience did the best job. Scale 3 which was standardized upon students in a General Psychology course did least well.

The third purpose of this study was to investigate the attitudes of the persons who were involved in the formation and development of the attitudes measured in this study. The use of five open-end statements in the study provided answers to the questions of (1) who most influenced attitude, and (2) the attitude of this person toward mathematics; as well as answers to what were the attitudes toward mathematics of (3) elementary teachers, (4) secondary teachers, and (5) parents. Results concerning this purpose indicated that teachers were predominantly the persons who were the most influential. The results concerning the attitudes of (1) the most influential person, (2) elementary teachers, (3) secondary teachers, and (4) parents were reported overwhelmingly as favorable. The unfavorable or ambiguous categories were responded to rarely by people taking a mathematics course. These unfavorable and ambiguous responses were usually made by people who took no mathematics course.

A Chi Square analysis for the attitudes of the person who was most influential was significant at the .01 level of confidence. A Chi Square analysis of attitudes for secondary teachers was significant at the .05 level of confidence.

Sex of the student was an extremely significant factor in the selection of a mathematics course. Females rarely chose the more difficult mathematics course. Attitude scores could be investigated in the light of this fact.

The large number of "favorable" responses with regard to the open-end statements gave rise to speculation concerning this occurrence. This might be due to the select nature of the group, students responding with what they felt was expected of them or an interaction of these and other factors. The favorable scores on the attitude scales raise the same question. Little differentiation of attitude scores with our sample may be responsible for the lack of correlation of attitude, as measured, with A.C.E. scores or with total course scores in Ma105 and Ch2. This made it impossible to partial out intelligence as measured by A.C.E.

APPENDIX

LIST OF STATEMENTS AND DIRECTIONS USED IN SCALE 3

DIRECTIONS: Following is a list of statements about the school subject, mathematics. The statements are arranged in pairs. For each pair of statements select the one statement you feel best represents your attitude. Place a plus sign (+) in front of the one statement you choose of each pair. Your score will NOT affect any grade.

1. ___Mathematics helps one to think logically in daily life.
___Mathematics helps one to act logically in daily life.

2. ___Mathematics should be used only in the classroom.
___Mathematics should be used only in areas of pertinent professions.

3. ___Mathematics helps in ordering the facts upon which deductions may be drawn.
___Most decisions in life are based upon an ordering of facts.

4. ___When the methods of mathematics are applied to issues, only one solution is possible.
___Most issues have more than one solution, the most advantageous one being the right one.

5. ___Many issues can be solved by resorting to devious but not unethical means.
___Most issues can be resolved advantageously if one tries hard enough.

6. ___Most mathematics teachers know their subject matter well.
___Most mathematics teachers enjoy teaching mathematics.

7. ___Mathematics is the "queen of the sciences."
___Mathematics is the most important subject to be taken.

8. ___Many people prefer to take mathematics.
___My parents encouraged me to do well in mathematics.

9. ___Mathematics is only for those who are well above average intelligence.
___Mathematics is only essential to those who are interested in careers involving math.

10. ___Mathematics is too difficult for many people.
___Most people cordially hate mathematics.

11. ___Mathematics could make life easier for me.
___Mathematics is necessary in some degree for any job.

12. ___I believe mathematics is only for men.
___I believe mathematics is only for women.

13. ___Mathematics discourages many people in school who are otherwise capable.
___My parents thought mathematics was difficult.

14. ___My parents believed mathematics to be important.
___My parents thought school subjects were important.

15. ___I am not capable of learning mathematics.
___I am not interested in learning mathematics.

16. ___Mathematics is all right for those who like it.
___I prefer some subject other than mathematics.

17. ___I enjoy mathematics.
___Mathematics is a challenging subject to me.

18. ___I find mathematics useful to me in daily life.
___I believe mathematics is an interesting subject.

19. ___To me mathematics is more or less boring.
___Mathematics is necessary but its emphasis is on the wrong things.

20. ___I believe mathematics is the best subject taught in school.
___I believe mathematics is the most beneficial subject I will ever take.

21. ___Nobody likes mathematics.
___No sane person would take mathematics.

22. ___Mathematics is the one subject that all young Americans should know.
___Mathematics is one of the most useful subjects I know.

23. ___Mathematics has its merits and fills its purpose quite well.
___Every year more students are taking mathematics.

24. ___Mathematics is not based on untried theories.
___Mathematics aims at power of execution or application.

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BIOGRAPHICAL SKETCH

Lester Garth Harrington was born in Dysart, Iowa, on November 16, 1928. From 1934 to 1946 he attended public schools in Florida. He served two years in the Marine Corps from 1946 through 1948. During the school year of 1947-1948 he attended the United States Naval Academy and College Preparatory School at Bainbridge, Maryland. In June, 1948, he entered the United States Naval Academy at Annapolis, Maryland. In 1949, he received his discharge from the Naval Service and returned to Florida. He attended the University of Florida during the years 1950 through 1954 and received an AB degree in Mathematics in February, 1954. During the years 1954 and 1955, he attended the University of Florida and received the MA degree in Psychology. During the year 1958, he was a Clinician in the Marriage and Family Clinic, Florida Center of Clinical Services, University of Florida. Since September, 1958, he has been a Psychology Trainee at the Veterans Administration Center, Biloxi, Mississippi.

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This dissertation was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of that committee. It was submitted to the Dean of the College of Arts and Sciences and to the Graduate Council, and was approved as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

January 30, 1960

A H Gomp
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